STATE & PRIVATE FORESTRY
FOREST HEALTH PROTECTION
SOUTH SIERRA SHARED SERVICE AREA

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To: Dean Gould, Forest Supervisor, Sierra National Forest
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From: State and Private Forestry, Forest Health Protection, South Sierra Shared Service Area

Subject: **Update and Risk ratings of Bark Beetle Activity on the Sierra National Forest**

Introduction

2014 was a particularly harsh year for the state of California's forests, trees, and people. Unusual warm weather, below-average precipitation, and catastrophic wildfires were record-setting. Extreme drought is an influential driver of many problems on forested lands. Forest trees with little water resource lose vigor and become highly susceptible to bark beetle attacks. While recent wildfires on Bass Lake and High Sierra Ranger Districts of the Sierra National Forest have compounded the number of susceptible trees prone to attack, salvage or tree-marking in fire-affected areas will ***not*** be discussed in this report. Discussion on marking-guidelines is a separate topic and will be covered in another document. This report focuses on potential and current bark beetle mortality in ***green*** areas in the Forest, not fire-affected.

High levels of mortality associated with bark beetles in the Forest did not start as recently as 2011, but ongoing since 2008. Some of the highest counts were detected in 2009 and 2013. Record low precipitation beginning winter of 2006-2007 did not improve until winter 2010-2011, but was a single season of above-average precipitation that did little to significantly affect beetle populations (Figure 1). According to Forest Health Monitoring Aerial Detection Surveys (2008-2014), overall bark beetle-associated mortality has been continuous and intensifying in various locations throughout Sierra NF (Appendix A) as drought has persisted. Identified patches with mortality due to bark beetles have been as large as 500 acres, with 3 attacked trees/acre. Losses of trees per acre have ranged from 2 per acre to as high as 10 (background mortality is considered <1 tree/acre/annually).

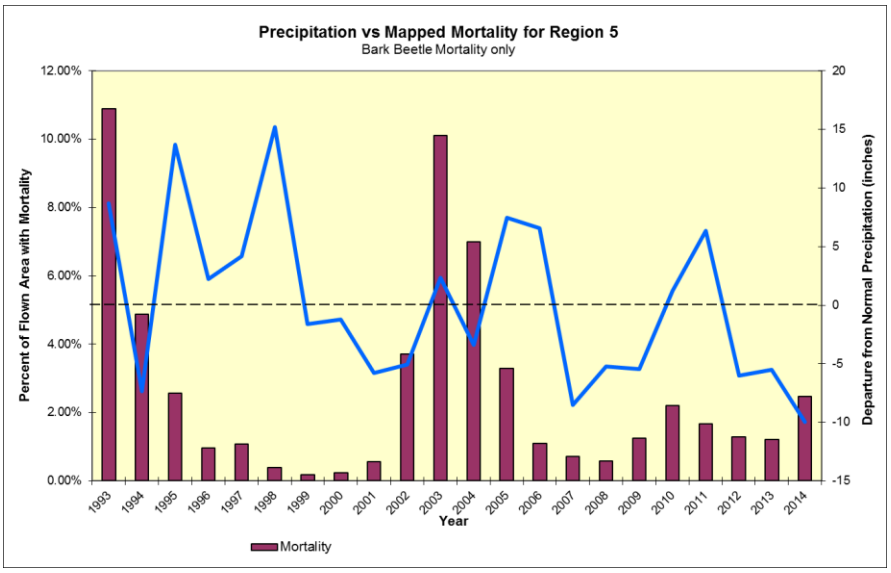

Figure 1. *Graph of mapped pest mortality vs. annual CA precipitation, 1993-2014. Source: www.ncdc.noaa.gov/temp-and-precip/climatological-rankings/index*

The high level of bark beetle-associated mortality occurring in Sierra National Forest is not unique, but widespread throughout southern Sierra Nevada. Yosemite National Park south through Tehachapi Mountains is experiencing mounting levels of beetle-kills. Bark beetle activity is mostly concentrated on pines, with higher levels of activity in the low elevation ranges of ponderosa pine. Natural stands and plantations have been continually losing large-diameter pines as beetles move through and primarily select bigger trees. There have been dramatic changes to many locations, particularly public campgrounds and private homesteads that have few but cherished high-value trees. Additional mortality in true firs, incense cedars, and Douglas-fir has also been building, but not to the same extent as pines.

Figure 2 (right, Bass Lake RD) and 3 (left, High Sierra RD). *Recent western pine beetle-kill in mature Ponderosa pine plantations, previously thinned.*

Pine plantations in both districts have been the hardest hit by western pine beetle (*Dendroctonus brevicomis*, WPB) due to their high proportions of even-aged trees, at high densities. WPB has targeted and thrived in these areas: stand basal areas above the threshold of eminent mortality (Oliver 1995) with 90% host composition, and stand diameter average of 13 inches or greater. These types of stand conditions are highly attractive to western pine beetle. Groups of up to 100 trees were attacked annually, 20-50 trees on average. The most prominently affected areas in High Sierra Ranger district have been plantations within Big Creek and Dinkey Creek watersheds: Nutmeg Saddle plantations, Peterson Mill Road, Barnes Mountain, and various locations along Dinkey Creek Road. Entire patches of older plantations that would have previously been regarded at lower risk – low basal area, minimal brush competition, and adequate spacing – were completely infested within a single year (Figures 2 and 3). Infestations within Nutmeg Saddle plantations have been intensifying and spreading throughout the area (Figure 4). Trees along the ridgeline or south-facing slopes were first attacked, but beetles have now migrated into all areas where ponderosa pines are grouped.

Figure 4. *Ongoing western pine beetle infestations in mature ponderosa pine plantations, Nutmeg Saddle, High Sierra Ranger District.*

On Bass Lake Ranger District, tree mortality is highly visible along the main highways. Many areas of the district considered "front country" felt the brunt of beetle attacks. Bass Lake, Pilot Peak, Central Camp, Nelder Creek watershed, and even within the town of North Fork are dotted with multiple red-colored pines on the landscape. In 2014, along east-face mountainsides of the San Joaquin River, several large pockets as large as 950 acres and 500 acres are infested, with 3 or more attacked trees/acre. About 1000 combined acres (2014) are infested by western pine beetle around Bass Lake: within campgrounds, next to homes, and along the primary roads around the lake (Figure 5). East of Hogan Mountain, an area of 500 acres was detected with ~20 attacked trees/acre; these same areas have been experiencing this level of mortality loss since 2011.

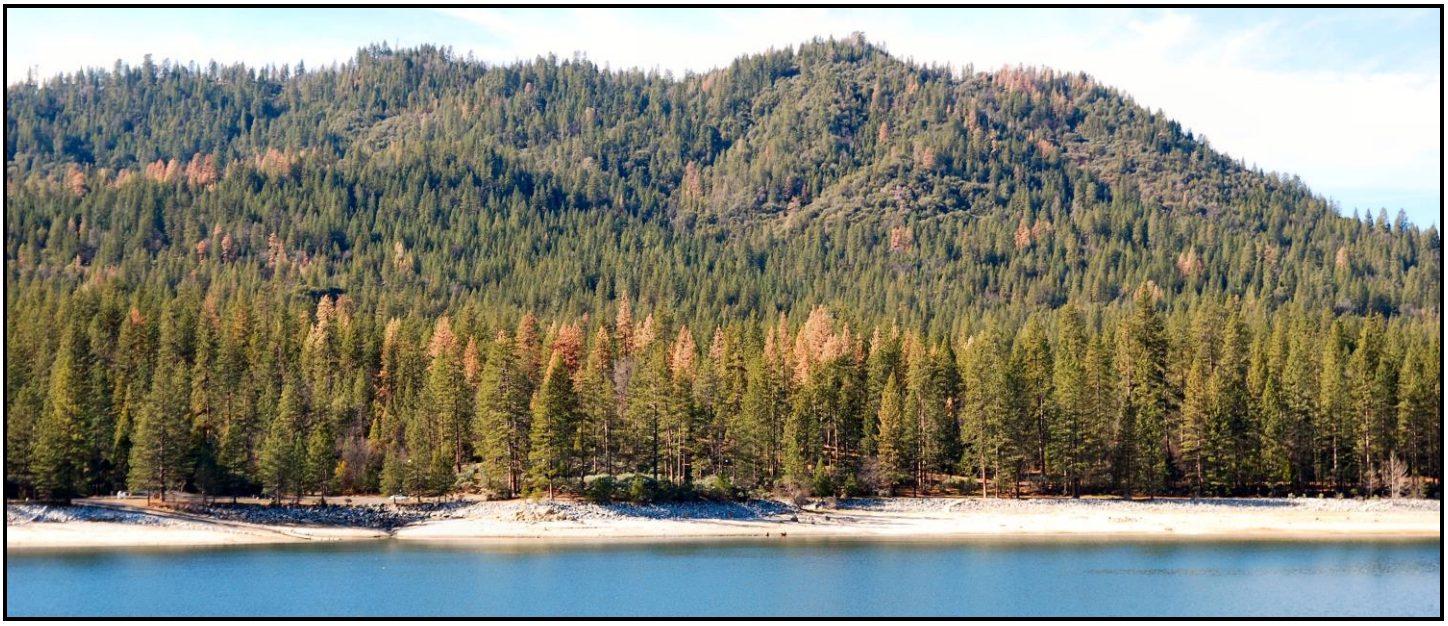

Figure 5. *2014 bark beetle infestations surrounding Bass Lake community, Bass Lake Ranger District.*

Sugar pines have been declining for multiple years throughout California, but due to multiple factors. White Pine Blister Rust (*Cronartium ribicola*) is an exotic pathogen, introduced nearly a century ago has been very slowly decimating most five-needled white pines from western forests. In the Sierra NF where populations of white pines are small or scattered, this gradual disappearance is unnoticeable but significant to stand diversity. Compounded with drought, all sizes and age classes are currently being killed by bark beetles. This accelerated loss of legacy-sized sugar pine affect cone production, stand diversity and composition.

Mortality of lodgepole and Jeffrey pines in the higher elevations are not as observable, but large polygons with mortality were detected in aerial detection surveys. Areas with 200-500 acre patches were noted with 1-3 trees recently dead per acre for both species. Jeffrey pine beetle (*Dendroctonus jeffreyi*) will outbreak a few years into severe drought events (Egan 2012). On Lake Tahoe Basin, Egan (2012) found that Jeffrey pine beetle reached epidemic or outbreak every drought period where PDSI (Palmer Drought Index) dropped below -3 for several consecutive years. Lodgepole pine mortality due to mountain pine beetle (*Dendroctonus ponderosae*) in California does not reach epidemic status as in Rocky Mountain regions, but can be just as devastating and stand-altering.

Winter storms initiated some of the beetle activity, or exacerbated conditions where beetles had previously infested. Green limbs or tops snapped in strong windstorms, created slash that was suitable habitat for new bark beetle infestations. Standing trees with damage are highly susceptible to attack. Dead and broken beetle-killed trees add to long-hour fuel loads and create road hazards for personnel and visitors. The high volume of dead timber in the forest created within this short time can be potentially dangerous.

Risk Mapping is geospatial analysis tool developed by Forest Health Technology and Enterprise Team (USDA Forest Service) to determine areas at “risk” for bark beetle infestation based on stand/site properties and conditions. Risk is defined as a 25% or more volume loss over the next 15 years, including background mortality. Maps show potential impacts of insects and diseases on various scales to help land managers assess changes and prioritize areas for possible treatment; maps can also be separated by damage agent to distinguish varying degrees of impact per agent. Appendix B and C are separate maps of Bass Lake and High Sierra Ranger District, respectively. For viewing ease, a section of each district was delineated to show potential risk associated with western pine beetle/ponderosa pines in

areas not yet previously or currently infested. Mortality surveys taken from (2003-2014) were overlaid with risk and removed to reveal *remaining* areas that have high potential for attack within the next few years. It was assessed that 78% of the Bass Lake Ranger District *within the analysis boundary* is still at high risk; High Sierra Ranger District sits at 84%.

It is expected that mortality will continue regardless of whether or not adequate precipitation returns to the region. Beetle populations are still fairly high and will disperse to look for new hosts. Due to the severity and prolonged nature of the current drought, above-normal rainstorms need to occur for several consecutive years. Current drought monitors show the southern Sierra Nevada in "exceptional" drought conditions and predictions for persisting. Forest trees will need more than several years of significant precipitation to recover vigor and regain sufficient resistance against bark beetles. Trees with prior root disease will still be at higher risk than those without, particularly in true firs. Fir engraver bark beetles (*Scolytus spp*.) typically surge 2-3 years into an ongoing drought, and anticipated to increase in 2015.

Despite expectations of mortality, strategies that improve individual tree and stand health are still strongly encouraged as prevention and resiliency measures. While these efforts reduce proportion of susceptible trees, mortality may still occur due to drought and high beetle populations – this has clearly been evidenced in the current outbreak on the Forest. Districts should still prioritize highest risk areas, but also expect that scattered mortality will continue regardless. Emergency tree removals should focus on priority areas where dead trees will be public and safety issues. Forest Health Protection support planning and management that prevent and mitigate bark beetle-related mortality. Technical assistance and potential funding opportunities for project implementation are available.

If there are further questions or concerns regarding this report and associated risk analysis, please do not hesitate to contact us.

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References.

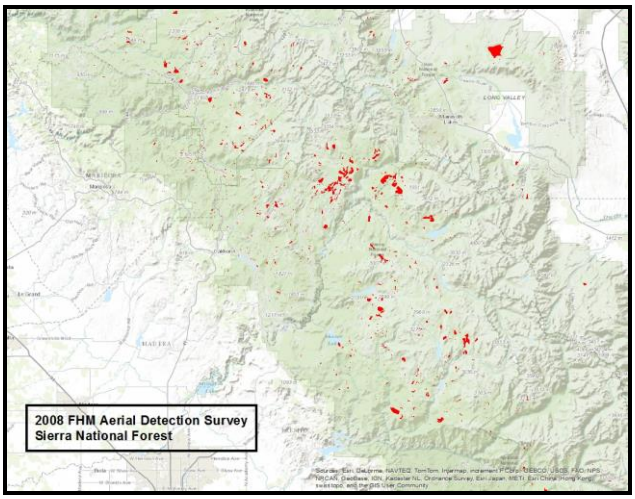
California Forest Pest Conditions 2005-2013. Publication of California Forest Pest Council, Sacramento, CA.

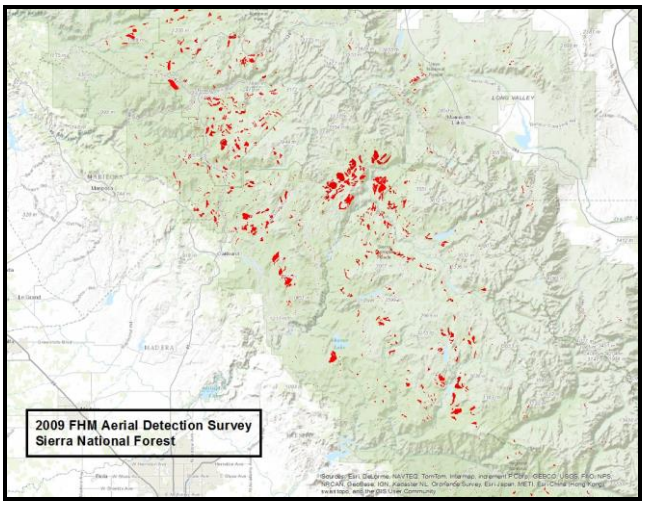
Egan, J. 2012. Jeffrey Pine beetle outbreaks and Forest Resilience within the Lake Tahoe Basin. *Presentation to Lake Tahoe Basin Management Unit, South Lake Tahoe, CA*.

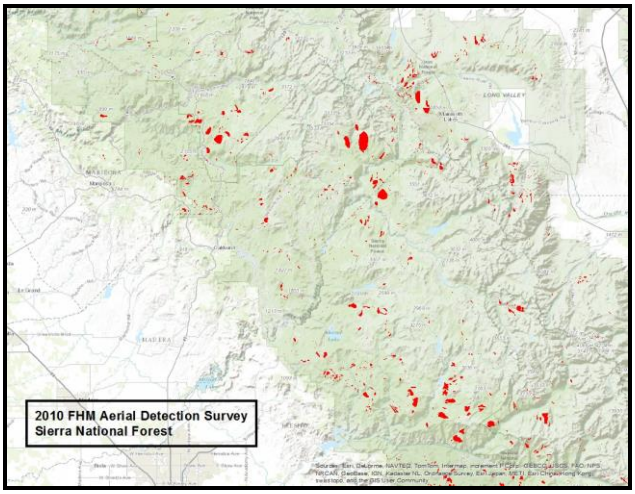
Furniss, R.L. and V.M. Carolin 1992. Western Forest Insects. USDA Forest Service, Miscellaneous Publication No. 1339.

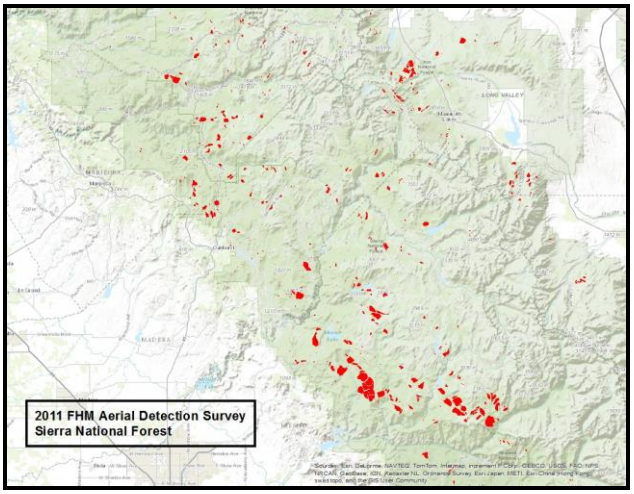
USDA Forest Service, Region 5, Forest Health Monitoring, Aerial Detection Surveys (2008-2014), Davis, CA.

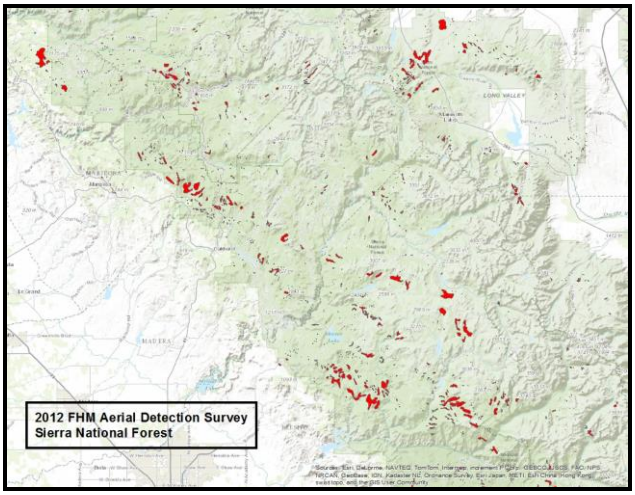
Appendix A. Chronology of Forest Health Monitoring Aerial Detection Surveys on Sierra National Forest, 2008 through 2014. *Note: maps show only bark beetle activity, pathogens are not included.*

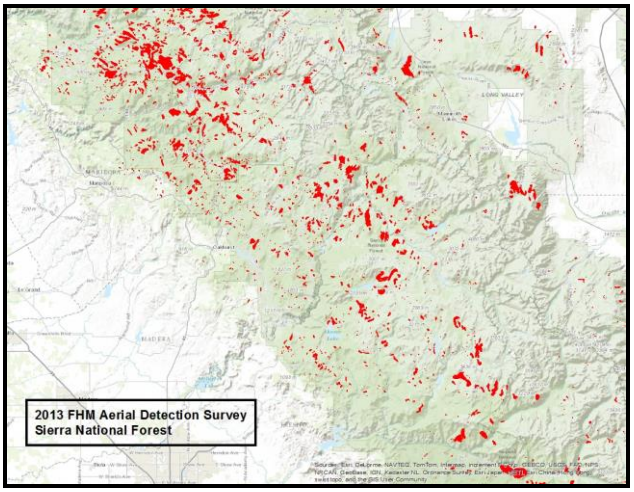


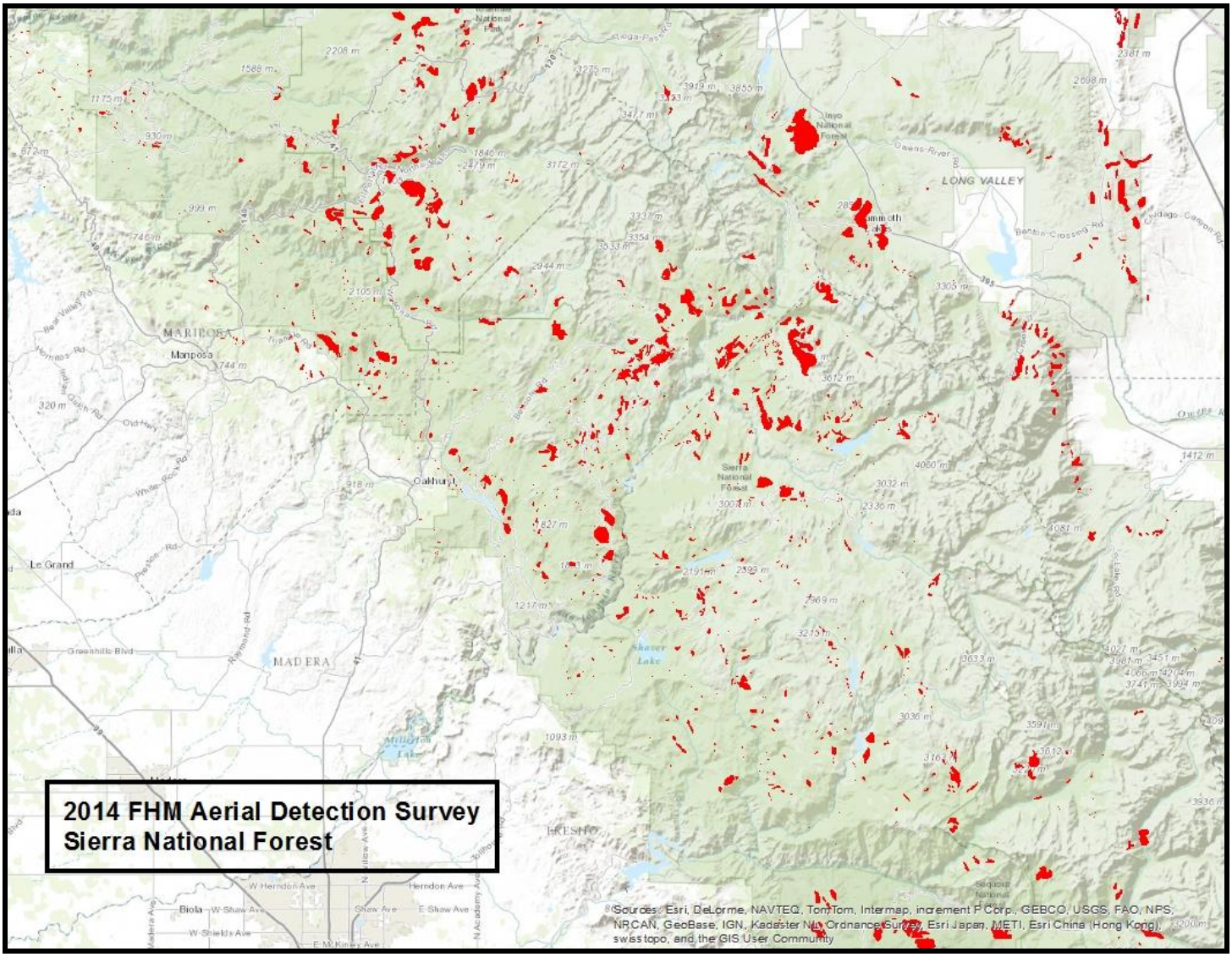






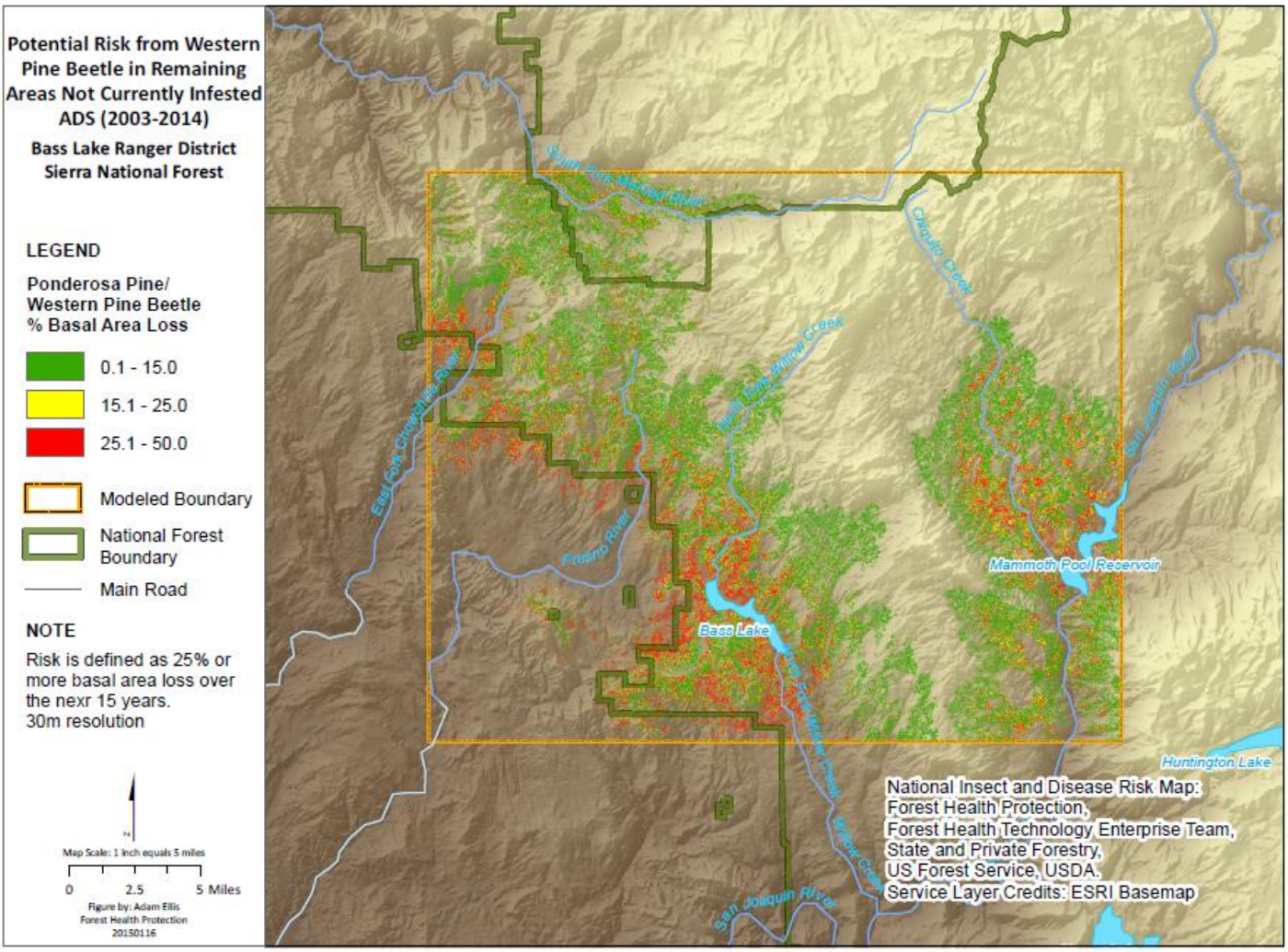





2014 FHM Aerial Detection Survey
Sierra National Forest
LONG VALLEY
MARIPOSA
Mariposa
Oakhurst
Le Grand
MADERA
FRESNO
Shaver Lake
Millerton Lake
Biola
Sources: Esri, DeLorme, NAVTEQ, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, and the GIS User Community

Appendix B. Western Pine Beetle Risk Map Rating, Bass Lake Ranger District, Sierra National Forest.

Note: modeled boundary delineated at a smaller scale for ease of viewing and analysis.



Appendix C. Western Pine Beetle Risk Map Rating, High Sierra Ranger District, Sierra National Forest.

Note: modeled boundary delineated at a smaller scale for ease of viewing and analysis.